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(54) **FUNCTIONALIZED SILICA FOR THE SYNTHESIS OF METAL NANOPARTICLES**

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CPC ***B22F 9/24*** (2013.01); ***C07F 7/025*** (2013.01); ***C22B 11/04*** (2013.01); ***B22F 2301/255*** (2013.01); ***B22F 2304/054*** (2013.01)

(58) **Field of Classification Search**
CPC B22F 9/24; B22F 2301/255; B22F 2304/054; C07F 7/025; C22B 11/04
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,480,784 B2	7/2013	Malekzadeh et al.	
2010/0317819 A1	12/2010	De Keyzer et al.	
2015/0343421 A1*	12/2015	Boday	B01J 20/28019
			428/402

* cited by examiner

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(57) **ABSTRACT**
The functionalized silica for the synthesis of metal nanoparticles includes a silica surface functionalized by a hydrazino-triazine derivative. A method of preparing the functionalized silica includes the steps of combining silica gel and a triazine derivative in a first organic solvent to form a mixture; heating the mixture for about two hours; isolating a white solid by filtration; washing the solid with the first organic solvent; suspending the white solid in a second organic solvent to form a suspension; adding hydrazine hydrate to the suspension while stirring; heating the suspension for about 3 hours to form the silica surface functionalized by a hydrazino-triazine derivative; and isolating the silica surface functionalized by a hydrazino-triazine derivative by filtration.

12 Claims, 10 Drawing Sheets